



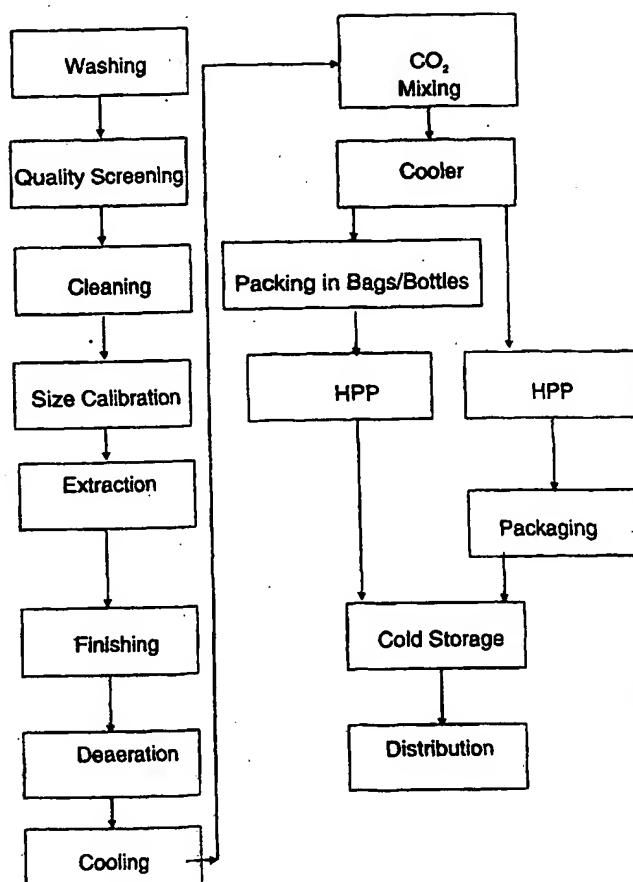
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : A23L 3/015, 3/3409		(11) International Publication Number: WO 99/65342
A1		(43) International Publication Date: 23 December 1999 (23.12.99)
(21) International Application Number: PCT/SE99/01045 (22) International Filing Date: 14 June 1999 (14.06.99) (30) Priority Data: 9802211-4 18 June 1998 (18.06.98) SE (71) Applicant (for all designated States except US): ABB AB [SE/SE]; S-721 83 Västerås (SE). (72) Inventors; and (75) Inventors/Applicants (for US only): TRÄFF, Anders [SE/SE]; Tillbringaregatan 16, S-724 76 Västerås (SE). ROVERE, Pierpaolo [IT/IT]; Boras San Giacomo, 88, I-33100 Maggiano in Riviera (IT). (74) Agent: ABB AB; Patent, Gideonsbergsgatan 2, S-721 78 Västerås (SE).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: METHOD FOR PROCESSING FOOD

(57) Abstract

A method for improving the taste of a food that is treated with a high pressure stabilisation in which a food is subjected to a pressure of 3000 bar or more. The method comprises subjecting a food to an over pressure of carbon dioxide before high pressure stabilisation treatment to reduce enzyme activity that produces, for example, off flavours. The method is characterised by the steps of preparing said food, mixing it into a suitable mixture of solids and liquids, subjecting said food to a vacuum to remove air, then mixing said food with carbon dioxide gas. The carbon dioxide gas is maintained at an over pressure less than a pressure at which said food is seen to sparkle after the high pressure treatment, and less than 100 bar. The food is then subjected to said high pressure stabilisation treatment. The advantage of the process is that the perceived taste of a food treated with a high pressure stabilisation treatment is improved.



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5 Method for processing food

TECHNICAL AREA

10 The present invention concerns a method for processing food to inactivate micro-organisms. A combination of high pressure and elevated temperatures may be used to inactivate certain micro-organisms and reduce and stabilise enzymatic activity in foods.

15 TECHNICAL BACKGROUND

The use of High Pressure Processing (HPP) at moderate temperatures, for example from 0 to 70 °C is known to inactivate common spoiling micro-organisms in food. The treatment works in a way that corresponds to pasteurisation, and is also referred to as high pressure stabilisation treatment. Because the temperature is kept low, a food with high quality with regard to taste, texture, nutritional values and health properties can be achieved.

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However, several studies have shown that HPP alone is not capable of inactivating the enzymes in food. The enzymes remaining in food after HPP affects the food in different ways. One example of this is described in an article entitled "Effects of Ultra-high Hydrostatic Pressure Treatments on the Quality of Tomato Juice", by S. Poretta, A. Birzi, C. Ghizzoni & E. Vicini, Elsevier, Food Chemistry 52, 1995, 35-41 with regard, for example, to apples and tomatoes. From WO 97/38591 it is known that remaining enzymes such as PME (pectinmethylesterase) can affect the consistency of the food,

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for example tomato products. It is also known from "High Pressure Process Concept for High Acid Products", by P.E. Pehrsson at a HPP symposium, Parma, April 1995, and "High Pressure Effects on Quality of Chilled Orange Juice", by M.E. Parish, High pressure in Biosciences and Biotechnology, K. Heremans (Ed) Leuven University Press, Belgium, 1997, that remaining enzymes can work in a natural way in a food, such as PME remaining in HPP treated orange juice and the cloud loss related to it.

10

Another effect observed when processing different types of foods with HPP, especially, but not only, tomatoes, carrots or fruits, for example oranges, apples etc., is that volatile compounds can be released to such an extent that they are perceived as an off-flavour. This may be due to smell, taste, or a combination of smell and taste. The reason for the release of volatile compounds is the partial inactivation of enzymes by HPP leading to enzyme pathways remaining in the product. These enzymes continue to work in the food system and can cause release or suppression of volatile compounds affecting the taste of the food as described for example in "Effects of High Pressure Treatment on Chopped Tomatoes", by P. Rovere et al, Industria Conserva, 72 1997, Italy.

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25 The effects of carbon dioxide in the preparation of food products have been studied..It is known from "Influence of Carbon Dioxide on Ethylene Synthesis of Tomato", by R. Zamponi, A Chaves, M.C. Anon, Sciences des Aliments, 10 (1990) 141-150, that CO₂ has an effect on the ethylene synthesis of tomato. CO₂ can inhibit the development of climacteric ethylene burst in tomato, associated with ripening of climacteric fruits, and keep the enzymes ACC and MACC at constant levels.

30

It is also known from a Japanese patent application nr. 5-7480, a method for a high pressure sterilising treatment, that sterilisation of food may be performed under lower pressures if carbon dioxide is dissolved in foods before or simultaneously with, a high pressure sterilising treatment. It is also known from a Japanese patent application nr. 4-135470 to sterilise food using high pressure that sterilisation of food may be carried out in a reduced time by the addition of carbon dioxide gas to a food in an apparatus for high pressure treatment.

HPP treatment of food produces food with high quality with regard to taste, texture, nutritional values and health properties. However some differences in taste and texture, compared with a fresh food, may still be observed after a HPP treatment.

SUMMARY OF THE INVENTION

The object of the present invention is to improve the taste of foods that are processed using high pressure (HPP). Further objects of the invention include to improve other properties such as aroma, colour and texture that affect the perception of freshness.

These and other objects are realised by a method described in claim 1 and other claims, in which the food is subjected to an over-pressure of carbon dioxide gas, or the addition of carbonic acid, before it is treated using high pressure (HPP).

The addition of low quantities of CO₂, or an amount of carbonic acid corresponding to the gas prior to HPP produces a food with improved perceived taste. The carbon dioxide gas is added to the food by way of an over-pressure of up to 100 bar over

the product prior to high pressure treatment. The reason for this is that the CO₂ interferes with at least one enzyme pathway, for example the Lipoxigenase (LPOX). The method provides therefore a means for reducing enzymatic activity. This effect
5 has been shown in panel tests to result in a superior taste with foods such as orange juice, grapefruit juice and apple pieces.

The primary advantage of the invention is that taste of a HPP
10 treated food is perceived to be better after carbon dioxide treatment. Another advantage is that the appearance and texture of the HPP treated food may also be improved. A further advantage is that the process is relatively simple to include in common HPP food processes, and uses carbon dioxide
15 as an active component, a naturally occurring and relatively cheap substance. A still further advantage is that the process equipment required has a relatively low cost because standard industrial components and measuring systems may be used.

20 BRIEF DESCRIPTION OF THE DRAWING

The enclosed drawing Figure 1 shows a process for the high pressure treatment of orange juice in a schematic block diagram.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

A food product is prepared in a suitable way for HPP. That preparation may include washing, peeling, cutting, slicing,
30 and/or squeezing, and mixing a food with other compounds etc. at a low or elevated temperature. The typical steps for a HPP process where a food is exposed to an over pressure of carbon dioxide before the HPP stage are:

-a food is peeled, cut, sliced, and/or squeezed and mixed at a low or elevated temperature.

-the mixture of solid, semi-solid and raw liquid food is cooled down to the lowest temperature possible, but not lower than the freezing point of the mixture

-the food is stirred in a tank under an over pressure of carbon dioxide

-the food is transferred directly into the high pressure process chamber or is packed in a suitable packaging material prior to being subjected to the pressure processing

-the food is processed by high pressure.

The exact over pressure of carbon dioxide used for a particular food is determined by experiment. For example, a series of food samples are exposed to increasing over pressures of carbon dioxide to find the highest pressure before which, the food after HPP treatment is observed to sparkle. That over pressure has been found to be up to 100 bar.

The time for which a particular food is exposed to an over pressure of carbon dioxide can vary from seconds up to several hours. The exact time for which the over pressure of carbon dioxide is maintained is determined by experiment, to find a time just less than a time after which the food after HPP treatment is seen to sparkle.

The Figure shows in a schematic block diagram a process for the high pressure treatment of, for example, orange juice in which the food is subjected to an over pressure of carbon dioxide. A method for processing orange juice according to the invention is as follows:

The proper raw material, oranges, is squeezed at a low temperature to extract orange juice and pulp. Better results

are obtained with the lowest possible temperatures, as close to 0°C as possible.

The orange juice is passed through a finisher, for example a type of filter or centrifuge, where an amount of pulp is defined and the orange juice and pulp mixture is de-aerated thereafter in the same vessel if possible. Alternatively de-aeration may be carried out in a separate vessel. From the de-aerator the orange juice mixture is cooled down close to 0°C and pumped to a tank where it is sprayed and/or stirred in the presence of an over-pressure of carbon dioxide gas.

A method for processing strawberries according to the invention is as follows:

The proper raw material, strawberries, are put into an extractor to make juice and/or pulp. Better results are obtained with the lowest possible temperatures, as close to 0°C as possible.

The juice and/or pulp is passed through a finisher, for example a type of filter or centrifuge, where an amount of pulp is defined and the juice and pulp mixture is de-aerated thereafter in the same vessel if possible. Alternatively de-aeration may be carried out in a separate vessel. From the de-aerator the juice mixture is cooled down close to 0°C and pumped to a tank where it can be mixed with a suitable amount of strawberry pieces, sugar and pectin. The mixture is then stirred in the presence of an over-pressure of carbon dioxide gas.

The process is carried out in the examples of both orange juice and a strawberry mixture for a sufficient time to dissolve enough of the carbon dioxide to obtain the required results, but not sufficient carbon dioxide to make the food sparkling. The food is then transferred directly into the high

pressure process chamber or is packed in a suitable package material prior to being subjected to the pressure processing, preferably into bottles or bags, and HPP treated as soon as possible.

5

Alternatively a food may be mixed with carbonic acid instead of being stirred in the presence of an over pressure of carbon dioxide. Sufficient carbonic acid is added to successive samples of a food and the food then subjected to high pressure treatment. The highest quantity of carbonic acid that may be added without causing a food to sparkle after a high pressure treatment is found for a given food. The same quantity of carbonic acid, expressed in terms of concentration of carbonic acid and quantity used, is then mixed with production quantities of the food before high pressure stabilisation treatment.

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It is preferable to use a vacuum stage to remove air from a food before mixing the food with carbon dioxide and subjecting the food to a high pressure stabilisation treatment. However, not every food is suitable for a vacuum or deaeration process. It is within the scope of the invention to process food without a vacuum stage.

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CLAIMS

1. A method for a high pressure stabilisation treatment of food, in which a food is subjected to a pressure of up to 3000
5 bar or more, which method comprises a means of reducing enzymatic activity in the food, **characterised** by a preparatory stage including the steps of:
-preparing said food and mixing said food into a suitable mixture of solids and liquids,
10 -mixing said food with carbon dioxide gas which is maintained at an over pressure less than a pressure at which said food is seen to sparkle after the high pressure treatment which over pressure is less than 100 bar,
and by a treatment stage including the step of:
15 -treating said food by subjecting said food to said high pressure stabilisation treatment.
2. A method for high pressure stabilisation treatment of food according to claim 1, **characterised** in that said method
20 includes a step in which said food is subjected to a vacuum to remove air after said step in which said food is prepared and mixed into a suitable mixture of solids and liquids and before said step in which said food is mixed with carbon dioxide.
- 25 3. A method for high pressure stabilisation treatment of food according to claim 2, **characterised** in that at least a part of residual air or oxygen in the food is replaced with carbon dioxide or carbonic acid before the high pressure processing treatment, in order to minimise the number and amount of
30 enzyme pathways that will work in the food after the processing.
4. A method for high pressure stabilisation treatment of food according to claims 1-3, **characterised** in that said food is

mixed with carbonic acid and then subjected to said high pressure stabilisation treatment.

5. A method to determine a suitable pressure of carbon dioxide for a high pressure stabilisation treatment of food in which a food is subjected to a pressure of 3000 bar or more, **characterised** by the steps of:

- successive samples of said food are subjected to carbon dioxide gas at a selected pressure of up to 100 bar,
- 10 -each sample of said food is in turn subjected to high pressure treatment,
- the highest carbon dioxide pressure used before a sample is seen to sparkle after the high pressure treatment is determined.

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6. A method to determine a suitable quantity of carbonic acid for a high pressure stabilisation treatment of food in which a food is subjected to a pressure of 3000 bar or more, **characterised** by the steps that:

- 20 -carbonic acid is added to successive samples of said food in increasing quantities,
- each sample of said food is then subjected to high pressure treatment,
- the highest quantity of carbonic acid added before a sample is seen to sparkle after the high pressure treatment is
- 25 determined.

7. A method to determine a suitable time for the exposure of a food to carbon dioxide gas for a high pressure stabilisation treatment of food according in which a food is subjected to a pressure of 3000 bar or more, **characterised** by the steps that:

- 30 -successive samples of said food are subjected to carbon dioxide gas at a selected pressure of up to 100 bar for different periods of time,

-each sample of said food is subjected in turn to high pressure treatment,
-the longest time used before a sample is seen to sparkle after the high pressure treatment is found.

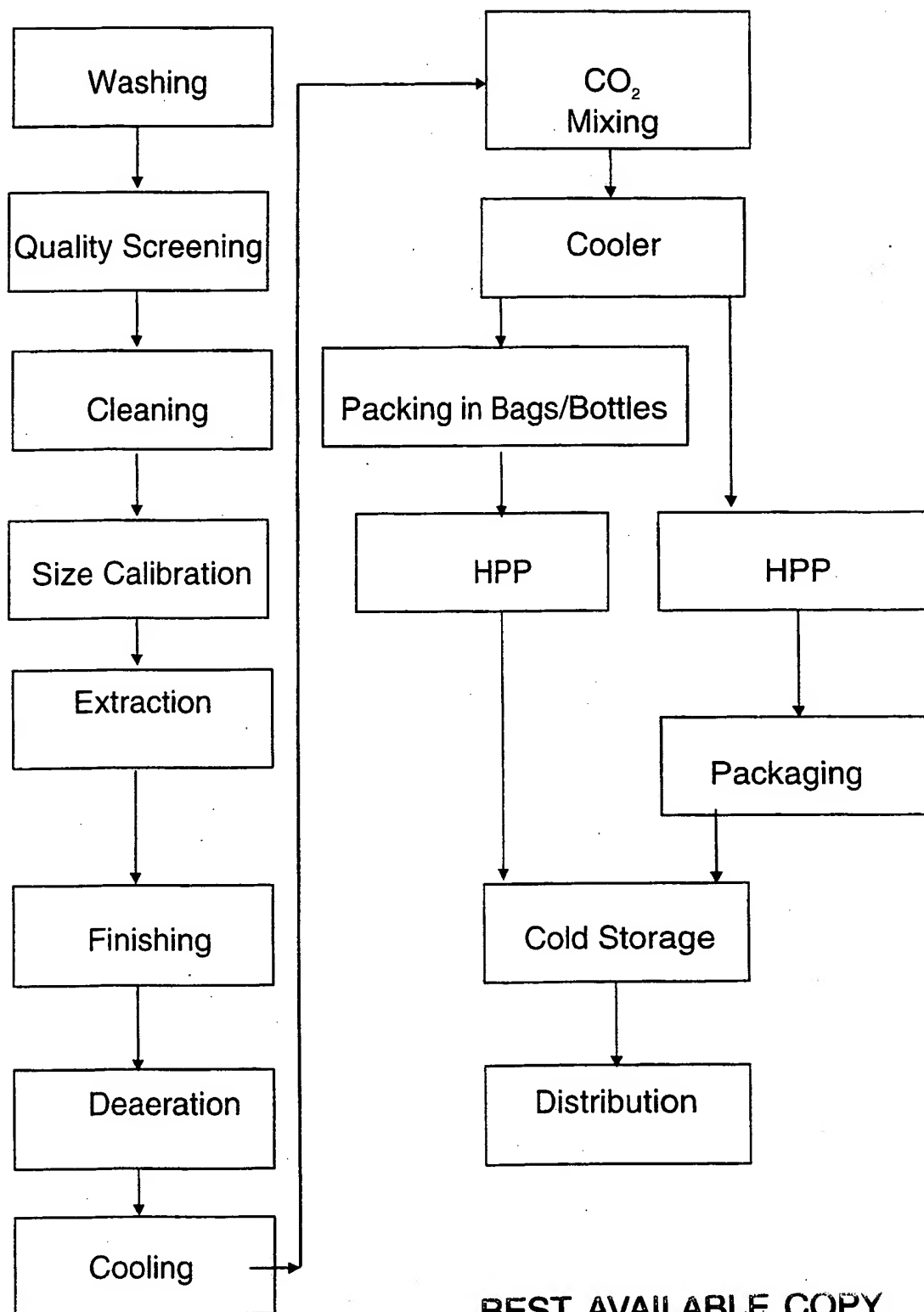
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8. The use of a method according to any of the claims 1-7 for improving the taste of a food.

9. A food treated by a high pressure stabilisation treatment
10 including a method according to any of the claims 1-7.

1/1

Figure



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/01045

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A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A23L 3/015, A23L 3/3409
According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)

IPC6: A23L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	Patent Abstracts of Japan, abstract of JP 4-135470 A (TOPPAN PRINTING CO LTD), 8 MAJ 1992 (08.05.92) --	1-9
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A	EP 0674845 A1 (SOCIETE DES PRODUITS NESTLE S.A.), 4 October 1995 (04.10.95) --	1-9

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5468508 A (WU ET AL), 21 November 1995 (21.11.95), abstract --	1-9
A	US 5393547 A (BALABAN ET AL), 28 February 1995 (28.02.95), column 1, line 47 - line 58; column 2, line 43 - line 58, abstract -- -----	1-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/08/99

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